What is claimed is:

1. A method of fabricating a magnetic nanotube comprising the steps of:

providing a plurality of bacterial magnetic nanocrystals, each of the plurality of bacterial magnetic nanocrystals having an outer layer;

providing at least one nanotube having an interior surface and an exterior surface, the at least one nanotube being able to absorb bacterial magnetic nanocrystals; and

contacting at least one surface of the at least one nanotube with at least a portion of the plurality of bacterial magnetic nanocrystals.

2. The method according to Claim 1, wherein the at least one nanotube is a peptide nanotube and the outer layer comprises protein.

3. The method according to Claim 2, wherein the step of providing the at least one nanotube comprises the step of producing the at least one nanotube by self-assembly of a peptide bolaamphiphile.

4. The method according to Claim 2, the step of providing the plurality of bacterial magnetic nanocrystals further comprising the step of synthesizing the bacterial magnetic nanocrystals by growing magnetic bacteria anaerobically, and the step of extracting the plurality of bacterial magnetic nanocrystals, wherein the step of extracting comprises:

disrupting harvested cells;

collecting the plurality of bacterial magnetic nanocrystals in a column with a magnet; and

removing a supernatant formed within the column, the supernatant comprising a suspension of the bacterial magnetic nanocrystals.

5. The method according to Claim 4, wherein the bacteria are chosen from the group comprising *Magnetospirillum magnetotacticum* MS-1, *Magnetospirillum gryphiswaldense*, and *Magnetospirillum magneticum* AMB-1.

6. The method according to Claim 3, wherein the peptide bolaamphiphile comprises bis(N-alpha-amido-glycylglycine)-1,7-heptane dicarboxylate.

7. The method according to Claim 1, the step of contacting comprising:

forming a nanotube solution comprising the at least one nanotube;

forming a nanocrystal solution comprising a buffer and a concentration of the plurality of bacterial magnetic nanocrystals;

optimizing the concentration of the plurality of bacterial magnetic nanocrystals in the nanocrystal solution;

mixing the nanocrystal solution and the nanotube solution; and

incubating the nanocrystal solution with the nanotube solution until the at least the portion of the plurality of bacterial nanotubes is substantially contacted on the at least one surface of the at least one nanotube.

8. The method according to Claim 7, wherein the step of incubating comprises substantially selectively incorporating the at least the portion of the plurality of bacterial magnetic nanocrystals on the interior surface of the at least one nanotube, and further wherein the step of optimizing comprises the step of diluting the concentration of bacterial magnetic nanocrystals to an optimal concentration, the optimal concentration being characterized by the at least the portion of the plurality of bacterial magnetic nanocrystals being substantially incorporated on the interior surface of the at least one nanotube and substantially none of the plurality of nanocrystals being contacted on the exterior surface.

9. The method according to Claim 8, wherein the optimal concentration results in a ratio in the mixing step of nanocrystals to nanotubes substantially in a range of about 27 to about 56 nanocrystals to nanotubes.

10. The method according to Claim 7, wherein the at least the portion of the plurality of bacterial magnetic nanocrystals is substantially immobilized on at least the exterior surface of the at least one nanotube, and wherein the optimal concentration results in a ratio in the mixing step of nanocrystals to nanotubes substantially in a range of about 550 to about 2800 nanocrystals to nanotubes.

11. The method according to Claim 7, wherein the buffer is characterized by a pH substantially in the range of about pH 5 to about pH 9.

12. The method according to Claim 8, wherein the at least the portion of the plurality of bacterial magnetic nanocrystals being substantially incorporated on the interior surface of the at least one nanotube align to form a linear chain on the interior surface of the at least one nanotube.

13. A magnetic nanotube comprising:

a plurality of bacterial magnetic nanocrystals, each of the plurality of bacterial magnetic nanocrystals comprising an outer layer;

a nanotube having an interior surface and an exterior surface, the nanotube being able to absorb the bacterial magnetic nanocrystals;

wherein the plurality of bacterial magnetic nanocrystals are contacted on at least one of the interior and the exterior surface of the nanotube.

14. The magnetic nanotube of Claim 13, wherein the at least one of the interior and the exterior surface is the interior surface, and wherein the plurality of bacterial magnetic nanocrystals are substantially aligned to form a linear chain on the interior surface of the nanotube.

15. The magnetic nanotube of Claim 13, wherein the outer layer comprises proteins, further wherein the nanotube comprises peptides, and wherein the outer layer of the plurality of the bacterial magnetic particles binds with the peptides.

16. The magnetic nanotube of Claim 13, wherein the plurality of bacterial magnetic nanocrystals are synthesized by bacteria selected from the group comprising *Magnetospirillum magnetotacticum* MS-1, *Magnetospirillum gryphiswaldense*, and *Magnetospirillum magneticum* AMB-1.

17. The magnetic nanotube of Claim 13, wherein each of the plurality of bacterial magnetic nanocrystals is substantially spherical and has an average diameter substantially in a range of about 50 to about 100 nanometers.

18. The magnetic nanotube of Claim 13, wherein the bacterial magnetic nanocrystals comprise at least one of magnetite (Fe_3O_4) and greigite (Fe_3S_4).

19. The magnetic nanotube of Claim 13 adapted for use as a magnetic nanowire.

20. The magnetic nanotube of Claim 13, the magnetic nanotube being characterized as ferromagnetic, and exhibiting a magnetic field of at least 4 mT.

21. The magnetic nanotube of Claim 13, wherein the magnetic nanotube is adapted for use in one of a cell separation system, a biological assay system, and an enzyme recovery system.

22. The magnetic nanotube of Claim 13, wherein the magnetic nanotube is adapted for use in cell manipulation.

23. The magnetic nanotube of Claim 13, further comprising at least one of a biological material chosen from the group comprising a peptide, a second protein, an enzyme, an antibody, a cell, a DNA, a gene, a virus, a bacteria, a pathogen, and a membrane, the at least one of the biological material attaching to at least one of the interior and the exterior surface of the nanotube.

24. The magnetic nanotube of Claim 23, wherein the biological material comprises the cell, the cell being a diseased cell, wherein the magnetic nanotube is adapted for use in cell manipulation, a magnetic probe being used to separate the diseased cell from a plurality of healthy cells.

25. The magnetic nanotube of Claim 13, further comprising one of a drug and a gene attached to one of the interior and the exterior surface, wherein the magnetic nanotube is adapted for use in one of a drug delivery system and a gene delivery system, wherein a magnetic field guides the one of the drug and the gene to a desired location.

26. The magnetic nanotube of Claim 13, wherein the magnetic nanotube is adapted for use in a magnetic resonance imaging system.